

ESA-024 Union Carbide Public Release Report

Introduction:

The facility has 3 boilers (1 coal fired, 2 natural gas fired). Although the coal-fired boiler has the capacity to meet recently experienced demands, a gas-fired boiler is being operated for reliability reasons. The steam demand has been decreasing over the past several years and is currently averaging 212 kLb/hr. The current operating philosophy yields a fuel split (on a BTU basis) of 65% coal / 35% natural gas. The coal-fired boiler has recently been returned to service after an extended forced outage.

The facility has a steam turbine generator (rated at 6,000 kW) as well as two turbine driven boiler feed pumps. The steam turbine generator has historically been operated in a fixed generation mode (at approximately 4,000 kW) due to mechanical problems in the governing system.

No condensate is being returned to the boiler plant.

Objective of ESA:

The objective of the ESA was to identify projects with significant energy savings potential while demonstrating the use of the US DOE Steam Tools Suite.

Focus of Assessment:

The assessment focused, primarily on the steam generating operating practices including effective operation of steam turbine generator. Additional activities included investigation of condensate and blow-down systems

Approach for ESA:

Due to history of combined coal and gas boiler operation and the need to operate both types of boilers simultaneously in the future, the steam generating plant was modeled in SSAT as a single boiler with a user-defined fuel that represented the 65%/35% historic fuel split. The btu values, boiler efficiencies, and fuel costs (per mmBtu) were taken into account in the modeling. The model was then adjusted for the anticipated 90%/10% operation, again using a user-defined fuel, boiler efficiency, and fuel cost based on the new split. Additional projects (steam turbine controls repair, condensate return increase to 40%, and boiler blow-down reduction) were also applied in combination with the user-defined fuel.

General Observations of Potential Opportunities:

Total natural gas expense for the year 2005 was approximately \$15.8 million. This figure was NOT used as a base line value for system modeling due to the following factors:

- 2005 natural gas usage was atypical due to the extended outage time of the coal-fired boiler (approximately 16 weeks vs. the typical 4 weeks).
- The extremely high cost of natural gas in the last quarter of the year which coincided with the coal boiler forced outage
- The total steam demand was decreasing throughout the year and averaged higher than the current and expected future demand.

The base-line impact fuel (a 65% coal / 35% gas mix) cost is \$5.64/mmBtu. The project fuel (90% coal / 10% gas mix) cost is \$3.20/mmBtu. A new demand level was established at approximately 212kLb/hr was set as the base line steam demand. The impact electrical cost is 3.2 cents/kWh.

Projects Considered

1. Revision of facility operating practices to shift operation of the coal-fired boiler to meet all demand. The operation of the gas-fired boiler would be required during forced and annual planned outages of the coal-fired boiler. Additionally, for reliability, the gas boiler would be maintained in "hot stand-by" by operating the gas pilot burners for all hours the coal-fired boiler is on-line. Annual net fuel savings are approximately \$6.8 million.
2. Increase condensate return from 0% to 40%. A significant quantity of condensate return piping is already in place but will likely require some repair and maintenance prior to being placed in service. Additionally, instrumentation at each steam customer would be required to measure quantity returned and to prevent the return of contaminated condensate.
3. Repairs to the steam turbine governing system will allow an increase in load for the turbine. Currently the turbine is operating in fixed generation mode.
4. Reduce boiler blow-down from 8% to 2% by increasing make-up water quality (switching from softened water to demineralized water). This project was ultimately rejected (from an energy efficiency standpoint) due to the high capital expense and negative effects on power generation - and therefore low return rate. Blow-down heat is currently recovered.

Near-term Opportunities – see definitions below.

- Operation of coal-fired boiler to meet all demand. Although considerable investment (\$500K - \$700K) in reliability-related matters (boiler feedwater system, boiler load control tuning, steam turbine steam-path repairs, etc.) would be required, the pay-back would still be on the order of 1 – 2 months and therefore a "Near Term" opportunity.
- Completion of the required connections and instrumentation to increase the condensate return to approximately 40% would require additional expense of \$200K - \$300K. With an annual return of greater than \$1 million yielding a 2 to 3 month payback, the cost is relatively low.

Medium-term Opportunities

- Re-establishing the steam turbine control system to automatic operation to meet steam demand (downstream pressure control), while costing (\$50K - \$150K), less than the other projects, yields a payback period of approximately one year.
- ❑ Near term opportunities would include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.
 - ❑ Medium term opportunities would require purchase of additional equipment and/or changes in the system such as addition of recuperative air preheaters and use of energy to substitute current practices of steam use etc. It would be necessary to carryout further engineering and return on investment analysis.
 - ❑ Long term opportunities would require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.

Natural Gas Savings – net savings of 61.2% compared to the model base line

- Near Term Opportunities – 63.1 % of base line gas use
- Medium Term Opportunities – increase of 1.9 % of bas line gas use

Management Support and Comments:

There was clearly a corporate commitment from DOW/UCC to formulate energy consumption reduction goals and strive to meet them. An organizational structure is already established to carry out planned projects.

One month following this energy assessment, the site announced additional production unit shutdowns, changes in contractual supply obligations and infrastructure reductions. Newly defined changes in demand will result in re-evaluation of these goals. Implementation is dependent on the, as yet undefined, optimum energy solution, to meet a redefined customer demand profile.

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